Mosquito Creek Ravine East Bank Detail Risk Assessment

Study Area

Scale is not known and north is to the top of the slide.

Landslide History in Mosquito Creek Ravine.

- The landslide probability is relatively high along the east bank of Mosquito Creek, as evident by the scars of several old failures, some of which have been documented over the past 20 to 30 years.
- The natural stability conditions have been adversely impacted by urbanization. Several timber-crib retaining walls were built a while ago to support back yards and are now deteriorating to the point where failures are imminent.

Landslide History in Mosquito Creek Ravine.

- Garden waste, excavated backfill and, in a few cases, household refuse has been dumped on to the slope, deteriorating the natural stability conditions.
- Historic flooding of Mosquito Creek caused past landslides, although recent channel improvements has curtailed such events.

Objectives.

- Conduct a detailed risk analysis for the buildings and underground services located near the crest eastern slopes in the Mosquito Creek ravine, with regards to the occurrence of a landslide. This analysis was done on a lot by lot basis.

- The assessment does not consider the potential impacts on the water quality and fish habitat in Mosquito Creek, and the potential impacts on the recreational trail and its users. This was completed in the earlier overview assessment.

Limitations.

- The study takes into consideration the proximity of the adjacent structures and services to the slope. It did not include an assessment on the integrity of these structures and many of the services.
- An assessment on the integrity of the buried sanitary sewer was completed.

Fieldwork.

- The site reconnaissance included both the slope and each of the 27 properties along the crest. Prior to conducting the slope assessment, areas of heavy brush were cleared by the CNV to improve visibility.
- The slope beneath each property was viewed and representative cross-sections measured from the trail up to the crest.

Assessed Parameters.

- Slope gradient and shape (i.e. down the vertical).
- Soil exposures or apparent composition.
- Groundwater discharge or concentrated surface runoff.

- Wet site indicators (i.e. hydrophitic vegetation).
- Signs of surface erosion or shallow slope movement.
- The presence of retaining walls.
- An estimate on the magnitude and runout from the earlier landslides.

- Distance from crest of slope to house, sundeck, sheds, etc.
- Distance from the crest to the services (where applicable and/or available).
- Signs of surface subsidence.

- Depth of the house foundation or sundeck footings and signs of settlement.
- Surface drainage conditions.
- Location of rock pits, sumps, footing drains and roof leaders.
- An estimate on the age and condition of the structure.

Sub-surface Information.

- The preliminary assessment in 2005 included drilling three deep test holes, installing two piezometers, and monitoring the piezometers over the winter.
- 19 more test holes were drilled using solid stem augers combined with Dynamic Cone Penetration Tests (DCPTs).

Sub-surface Information.

- Twelve Dynamic Cone Tests (DCTs) were performed on sites that were inaccessible to the portable auger rig.

Data Analyses

- The information collected during the field program was used to generate typical cross-sections through each of the twenty-seven properties.
- The cross-sections included the profile from the slope survey, the stratigraphy as determined from drilling and surface exposures, and the groundwater levels as determined from surface discharge and the piezometers installed during the preliminary field assessment.

Data Analyses.

- The location of houses, sundecks, sewer mains and other structures were noted on the cross-sections.
- Tension cracks or surface subsidence were also presented on the cross-sections as indicators of a probable failure plane.

Stability Analyses.

- Two-dimensional slope stability analyses were conducted using the cross-sections prepared for each property.
- The soil strength parameters were determined from correlations with the in-situ test results and from back-analyses of representative slopes where landslides have occurred.

Stability Analyses.

For each of the 27 properties, the slope stability analysis was used to determine:

- the factor of safety of a general slope failure;
- the factor of safety of a slope failure large enough or extending back far enough to directly impact on various elements at risk such as the house, sundeck, and services.

	Rating	Criteria
Landslide Probability P (H) Under Static Conditions	Low	Factor of Safety > 1.3 under static conditions. Typical slopes with this rating are: 32° or flatter; No signs of slope movement or past landslides on the slopes below the property. Slope stabilization or retaining wall (if present) has been engineered.
	Moderate	Factor of Safety between 1.1 and 1.3 under static conditions. Typical slopes with this rating are: 32 to 37° no retaining wall no random fill or yard waste coniferous forest no signs of slope movement or past landslides.
	High	Factor of Safety <1.1 under static conditions. Typical slopes with this rating are steeper than 37°, or less than 37° but with any of the following: non-engineered retaining wall random fill or yard waste on the slope or at the crest primarily deciduous forest signs of slope movement or past landslides considerable seepage present on the slopes.

What is the specific risk?

- The risks to specific structures depend on the probability of a landslide occurrence, the magnitude of the landslide, its probability of spatial interaction with the structure and the vulnerability of the structure.

	Rating	Criteria
Partial Risk To Structure P (HA)	Very Low	Factor of Safety at structure >2.0.
	Low	Factor of Safety at structure 1.5 to 2.0.
	Moderate	Factor of Safety at structure 1.3 to 1.5.
	High	Factor of Safety at structure 1.1 to 1.3.
	Very High	Factor of Safety at structure <1.1.

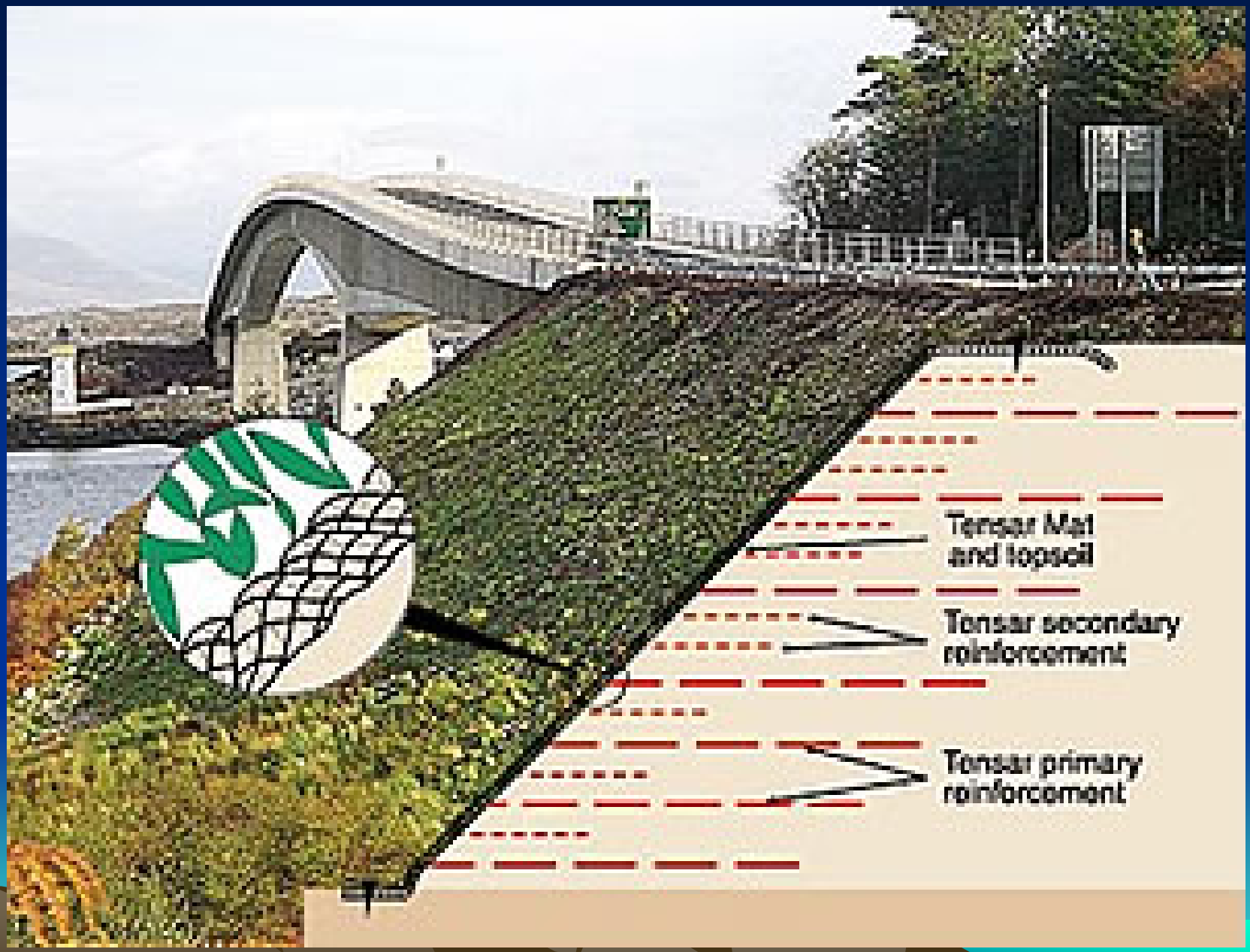
	Rating	Criteria
Vulnerability V (L: T)	Low (Loss or Damage)	Structure founded on piles or foundations extended to till or other stable material. If designed appropriately, the structure should not be undermined but may suffer minor damage if a landslide occurs.
	Moderate (Loss or Damage)	Structure is founded on deep spread footings or the foundations walls are relatively high and rigid. Or the landslide is expected to undermine only a small portion of the house. A moderate level of damage should be repairable, except to sundecks.
	High (Loss or Damage)	Structure is founded on shallow spread footings (or no footings) and could be readily undermined by the landslide. A significant portion of the outside wall could be undermined and/or the structure would probably suffer significant damage. Repairs may be extensive.

R (S) = P (HA) x V (L: T)		**V (L: T)**		
		Low	Moderate	High
P (HA)	Very low	***Very Low***	***Very low***	***Low***
	Low	***Very Low***	***Low***	***Moderate***
	Moderate	***Low***	***Moderate***	***High***
	High	***Moderate***	***High***	***Very High***
	Very High	***High***	***Very High***	***Extreme***

What next?

- Lots that have a high specific risk to the structure or greater must be reviewed by a geotechnical engineer and stabilization measures developed to reduce the specific risk to moderate or lower.
- Conceptual options have been presented for the lots that require risk mitigation.

Conceptual designs


Tensar Mat
and topsoil
Tensar secondary
reinforcement
Tensar primary
reinforcement